Determining the drivers of chaparral conversion in a southern California fire scar

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Chaparral

Historic Fire Regime

http://quietwarriorracing.blogsoot.com/2013/09_lost-fire-travel-management-tools-trail.html

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Vegetation recovery



Type Conversion

- "Changes in vegetation type caused by changes in the external environment" (<u>The Ecological Importance of Mixed-Severity Fires</u>, 2015)
- Loss of biodiversity and ecosystem services
- Many potential drivers





Sage Scrub

Photo: Scott Gibson

Exotic annuals













Hypothesized conversion model



Mature chaparral

Need to scale to landscape



Questions:

- Q1: How widespread is chaparral conversion to grass on a larger spatial scale?
- Q2: What is driving the observed chaparral conversion?
- Q3: What other vegetation fluxes are occurring?





Study Area

- 2003 Piru Fire Scar
- Average Precipitation of 620mm/yr
- Average Summer Temperatures of 91.4F
- Number of Fires 1-7

Data Sets

1930's Aerial Imagery

2009 Orthoimagery



- Generate 645 random points stratified by elevation, aspect, and number of fires
- Determined vegetation type
- Relative abundance



• Determine Vegetation Type



- Upload climatic, topographic, and Fire Variables
 - Mean annual precipitation w/ 800m resolution(Oregon State University PRISM)
 - Maximum August temperature w/ 800m resolution (PRISM)
 - Minimum January temperature w/800m resolution (PRISM)
 - Maximum August vapor pressure deficit w/800m resolution (PRISM)
 - Maximum January vapor pressure deficit w/800m resolution (PRISM)
 - Slope w/ 10m resolution
 - Southwestness w/ 10m resolution
 - Distance from Roads w/ 500m resolution (US Census Bureau TIGER)
 - Number of Fires (Cal Fire FRAP)
 - Number of Short-Interval Fires(Cal Fire FRAP)

It Takes (At Least) Two to Tango

"A **single** short-interval fire is **insufficient** to effect this type conversion" –Keeley and Brennan 2012

VPD

Low humidity & high temp: As air warms it expands and has the ability to to hold more water vapor.



High humidity & low temp: As air cools and contracts vapor concentrates and can fall or condense out of the air as water.

TEMP		RELATIVE HUMIDITY													
°C	۰F	100%	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%
15	59	0.0	0.8	1.7	2.5	3.4	4.2	5.1	5.9	6.8	7.6	8.5	9.4	10.2	11.1
16	61	0.0	0.9	1.8	2.8	3.7	4.6	5.5	6.4	7.3	8.2	911	10.0	10,9	11.8
17	63	0.0	1.0	2.0	2.9	3,9	4.9	5.8	6.8	7.8	8.8	9.7	10.6	11.6	12.6
18	64	0.0	1.0	2.0	3.1	4:1	5.1	6.2	7.2	8.2	9.3	10.3	11.3	12.4	13.4
19	66	0.0	1210	2.2	3.3)	4.4	5.5	6.6	7.7	6.8	9.9	11.0	12.1	13.2	14.3
20	68	0.0	1.2	2.4	3.5	4.7	5.9	7.0	8.2	9.4	10.6	11.7	12.8	14.0	15.2
21	70	0.0	1.2	2.4	3.7	4.9	6.2	7.4	8.6	9,9	11.1	12.4	13.7	14.9	16.1
22	72	0.0	1.3	2.6	3.9	5.3	6.6	7.9	9.2	10.5	11.9	13.2	14.5	15.8	17.2
23	73	0.0	1.4	2.8	4.2	5.6	7.0	8.5	9.9	11.3	12.7	14.1	15.4	16.8	18.2
24	75	0.0	1,5	3.0	4.5	5.9	7.4	8.9	10.4	11.9	13.4	14.9	16.4	17,9	19.4
25	77	0.0	1.6	3.2	4.8	6.4	8.0	9.5	11.1	12.7	14.3	15.9	17.4	19.0	20.5
26	79	0.0	1.7	3,4	5.1	6.7	8.4	10.1	11.8	13,4	15,1	16,8	18.4	20.1	21.8
27	81	0.0	1.8	3.5	5.3	7.1	8.9	10.7	12.4	14.2	16.0	17.8	19.6	21.3	23.1
28	82	0,0	1.9	3,8	5.7	7.6	9.6	11.4	13.3	15.1	17.0	18.9	20.7	22.6	24.5
29	84	0.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.1	24.1	26.1
30	86	0.0	2,1	4.2	6.4	8.5	10.6	12,7	14.8	17.0	19,1	21.2	23.3	25.4	27.5
31	88	0.0	22	4.5	6.7	9.0	11.2	13.4	15.7	17.9	20.2	22.4	24.6	26.9	29.1
32	90	0.0	2.4	4.7	7.1	9.5	11.9	14.2	16.6	19.0	21.3	23.7	26.1	28.4	30.8
33	91	0.0	2.5	5.0	7.5	10.0	12.5	15.0	17.6	20.1	22.6	25.1	27.6	30.1	32.6
34	93	0.0	27	5.3	8.0	10.6	13.3	15.9	18.6	21.2	23.9	26.5	29.2	31.8	34.5

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- Variable Percent Independent Effect
 - Hierarchical Partitioning Analysis
- Correlation Direction
 - Mann-Whitney Test

Questions:

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Observed Vegetation Fluxes



Chaparral Conversion



Percent Independent Contribution

Observed Vegetation Fluxes



Sage Scrub Conversion to Chaparral



Percent Independent Contribution

Sage Scrub Conversion to Grass



Percent Independent Contribution

Conclusions

- Q1: How widespread is chaparral conversion to grass on a larger spatial scale?
 - Chaparral \rightarrow grass relatively small
 - Chaparral \rightarrow sage scrub more common
- Q2: What is driving the observed chaparral conversion?
 - Site aridity
- Q3: What other vegetation fluxes are occurring?
 - Sage scrub more dynamic, equal conversion to grass and chaparral

Hypothesized conversion model



Mature chaparral

Vegetation conversion model

